



SNPP, NOAA20 and 21 VIIRS RSB calibration performance and inter-comparison assessment

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VIIRS RSB		
Band	CW (nm)	BW (nm)
M1	412	20
M2	445	18
M3	488	20
M4	555	20
M5	672	20
M6	746	15
M7	865	39
M8	1240	20
M9	1378	15
M10	1610	60
M11	2250	50
I1	640	80
I2	865	39
I3	1610	60

- Introduction
- Methodology
 - Vicarious approaches (SNO, desert, Dome C and DCC)
 - Data: NASA SLIPS C2 L1B for SNPP and NOAA21
- Results
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- Summary



Vicarious approaches



Pseudo-Invariant Calibration Sites (PICS):

- PICS approaches include desert (Libya 4) and Dome C
- Near-nadir, 16-day repeatable orbits for Libya-4, daily overpasses for Dome C in Antarctic summer.
- Target area of 25 x 25 km. Employ semi-empirical (desert) and empirical (Dome C) BRDF correction. BRDF coefficients derived initial years of on-orbit measurements

DCC approach

- DCC pixels collected over western tropical Pacific. *Mu et al. "Optimization of a Deep Convective Cloud Technique in Evaluating the Long-Term Radiometric Stability of MODIS Reflective Solar Bands", Remote Sensing, vol. 9 (6), issue 535, 2017.*

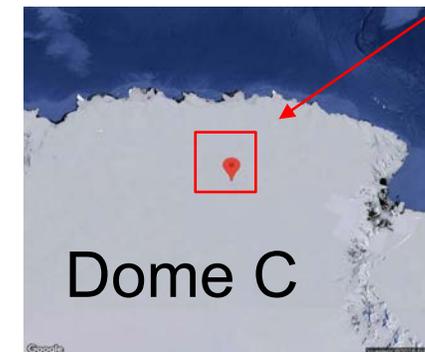
Impact due to RSR differences: Correction applied based on SBAF derived using historic SCIAMACHY hyperspectral data

Google Maps 28°36'00.0"N 23°24'00.0"E



Libya 4

25 x 25 km



Dome C

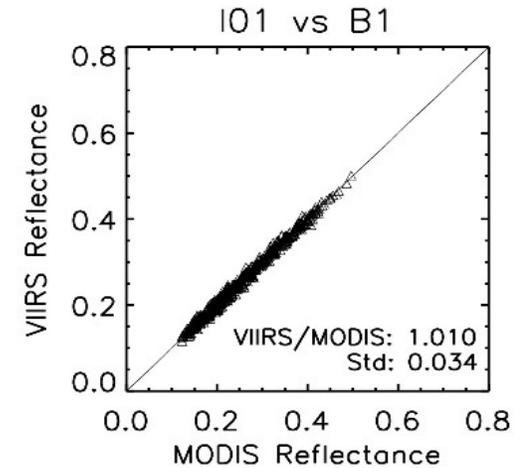


Vicarious approaches



Simultaneous Nadir Overpasses (SNO)

- Aqua MODIS used as a transfer radiometer for SNPP, NOAA20/21 intercomparison. TOA reflectance ratio between VIIRS/MODIS from high-latitude SNO (<3 minutes, two-line element), one SNO every 3-4 days
- No BRDF correction applied
- Correction for RSR mismatch based on a scene-averaged SCIAMACHY hyperspectral profile over typical high-latitude
- Larger uncertainties in some SWIR bands (compared to the VIS/NIR bands) likely due to their high sensitivity to atmospheric conditions



Pixel-by-pixel match from SNO on Oct 8, 2019



Spectral band adjustment factor (SBAF)*



SBAF between NOAA20 and 21 RSB

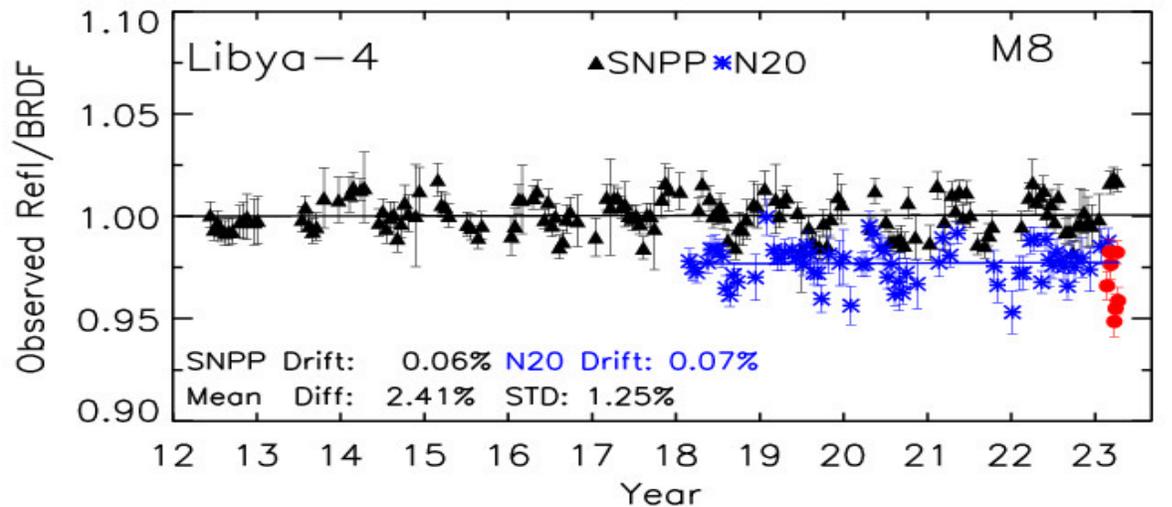
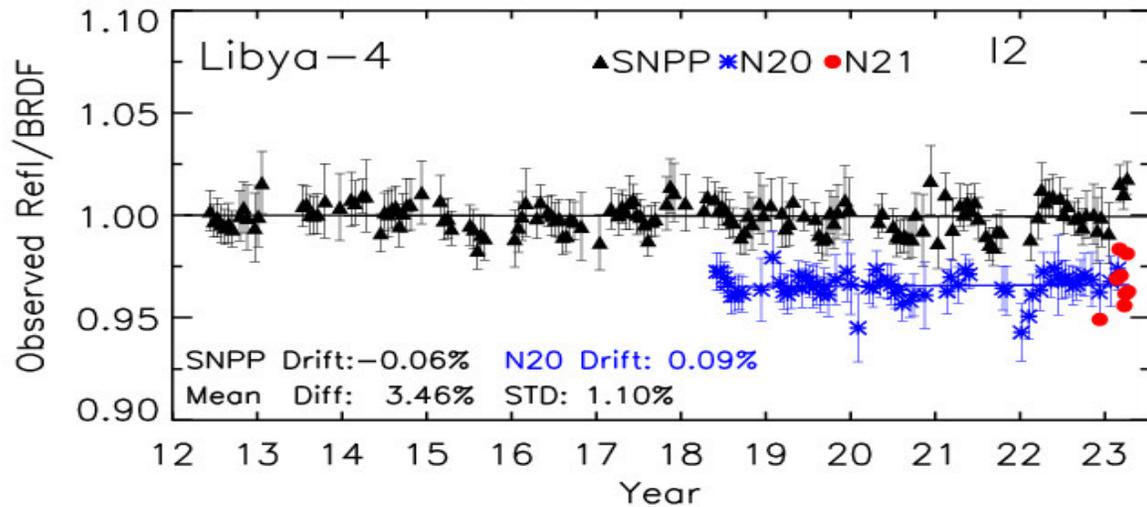
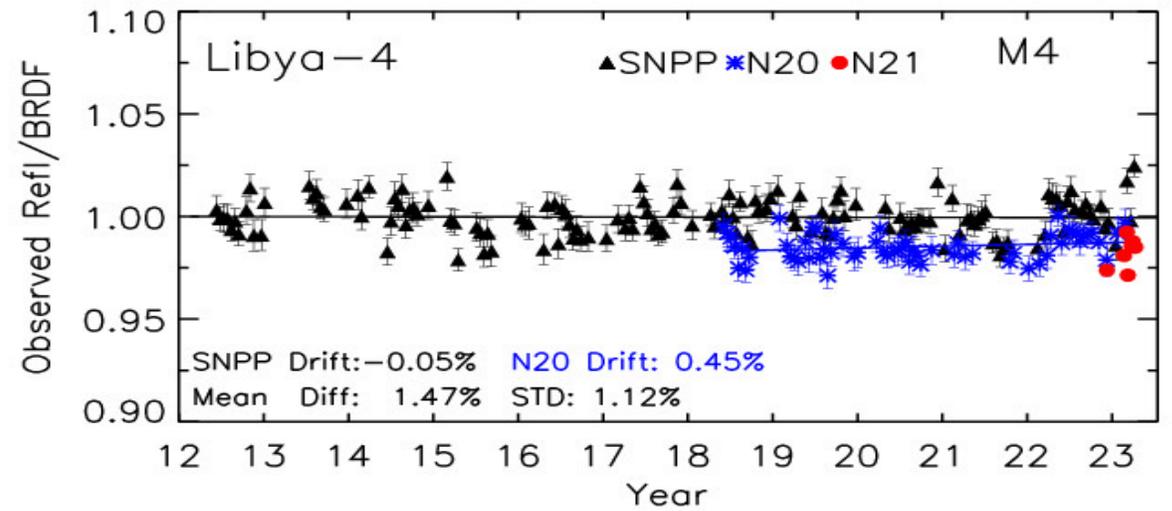
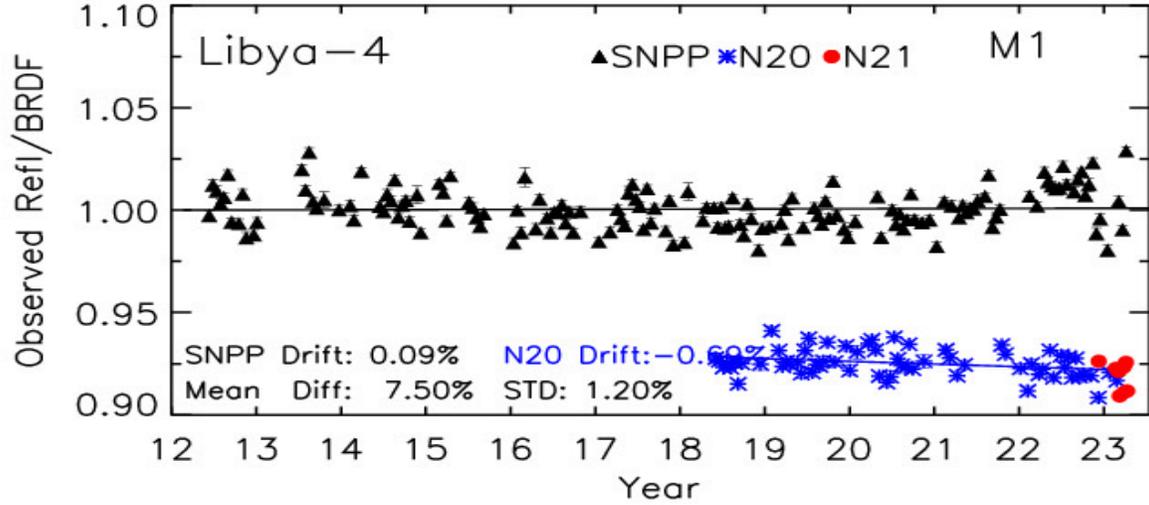
Band	M1	M2	M3	M4	M5	M7	I1	I2	M8	M10	I3
Desert	0.9966	0.9987	0.9995	0.9933	1.0073	0.9957	0.9983	0.999	0.9892	0.9925	0.9947
Snow	0.9974	0.9999	1.0009	1.0018	1.0009	0.9923	1.0001	0.9988	1.0029	N/A**	N/A
Ocean	0.9969	0.9987	1.0033	1.008	0.9901	0.9902	1.0056	0.9959	0.9997	N/A	N/A
Cloud	0.9974	0.9996	1.0011	1.0043	1.0034	0.9954	0.9986	0.999	0.9944	0.9787	0.9763

*The SBAF correction is determined using historic hyperspectral observations from SCIAMACHY, one of ten instruments aboard of ESA's Environmental Satellite, ENVISAT

** Large variations (>3%) in SBAF for different scene types

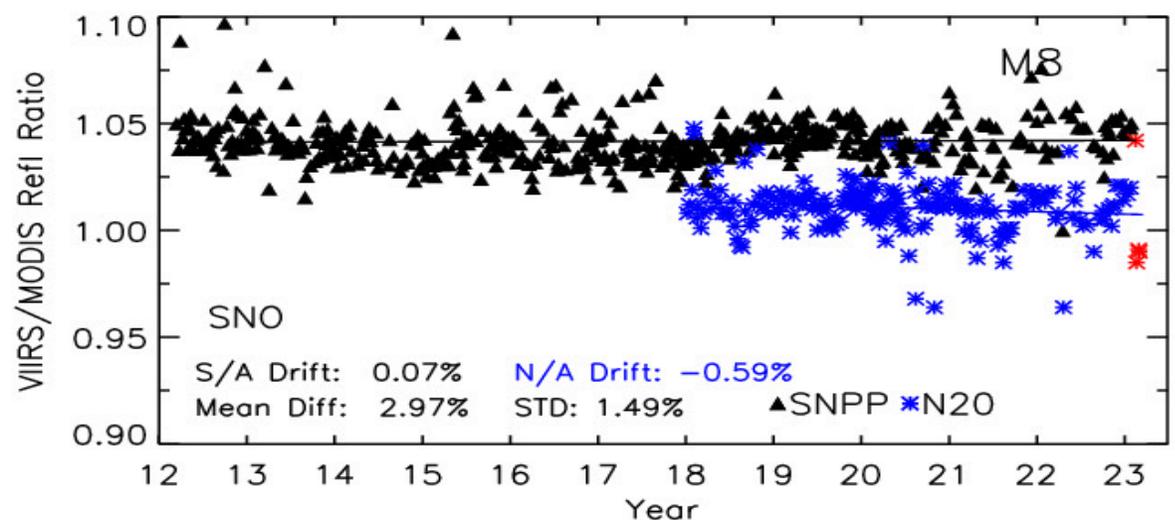
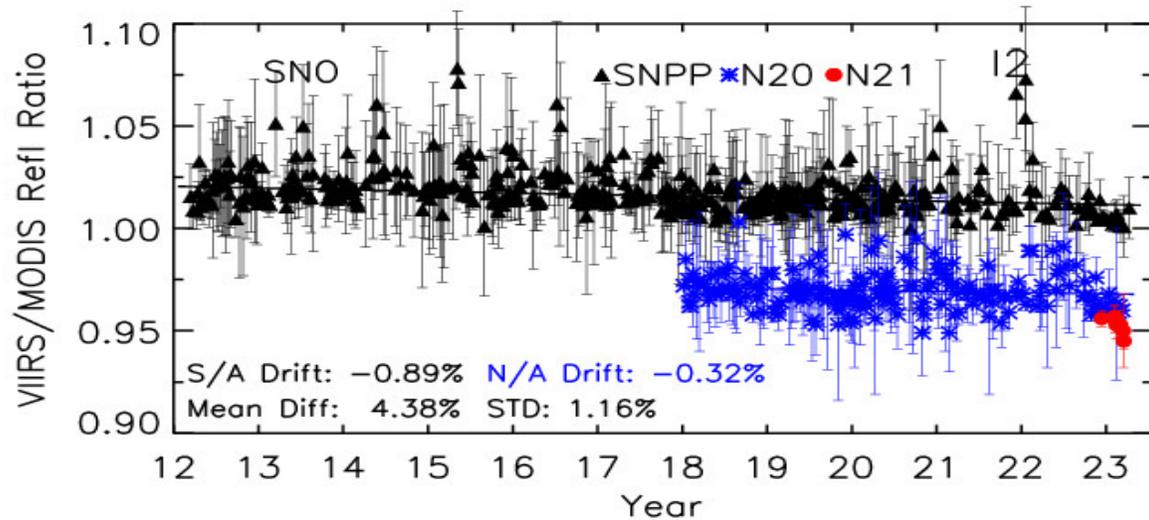
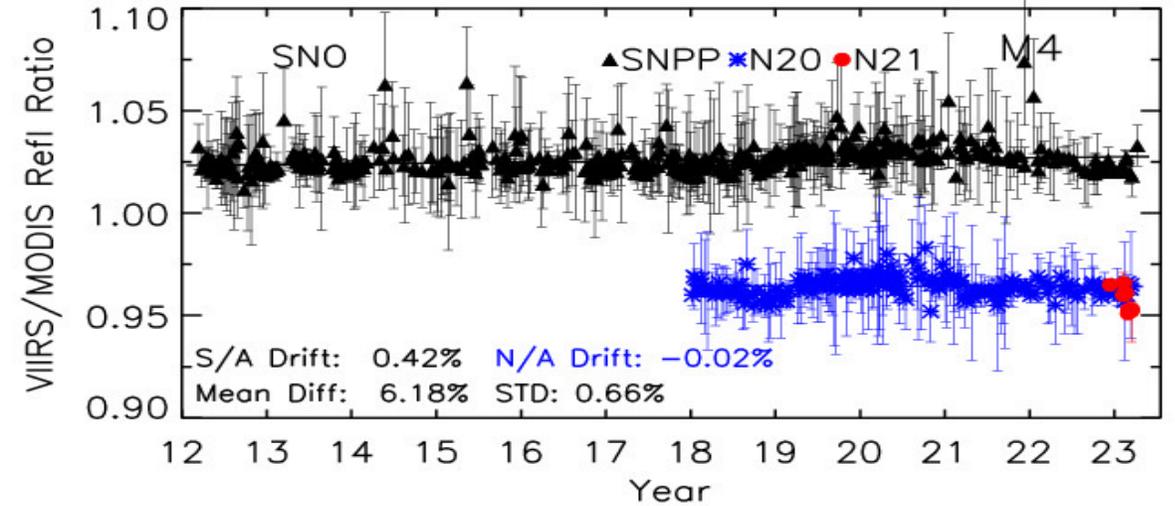
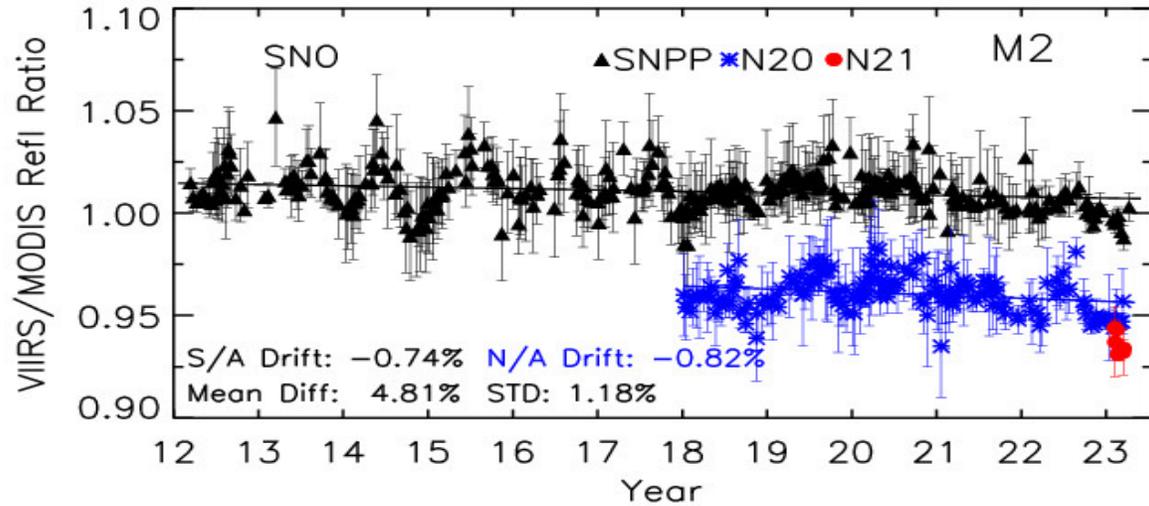


Reflectance trends over desert site



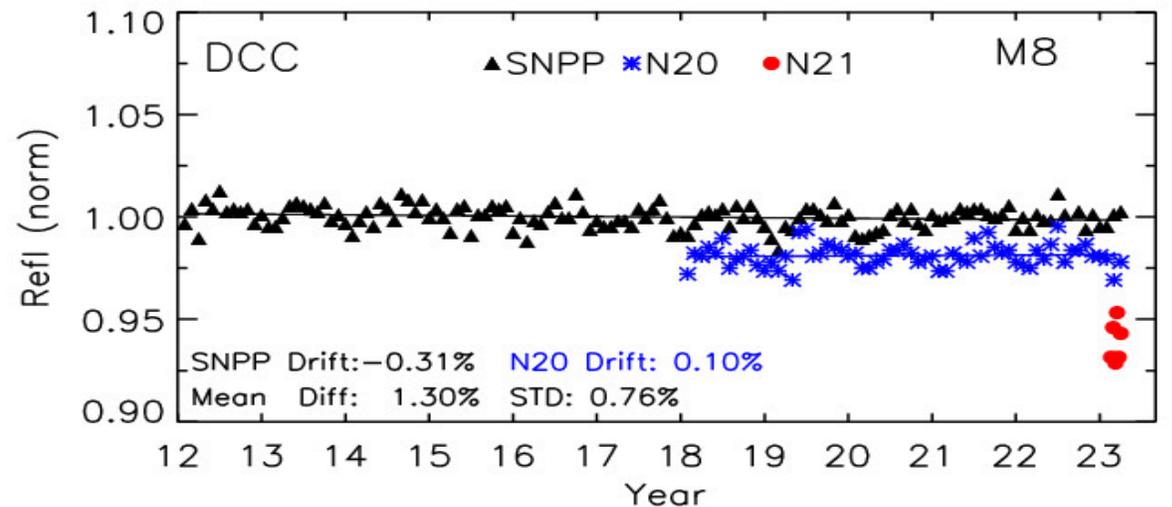
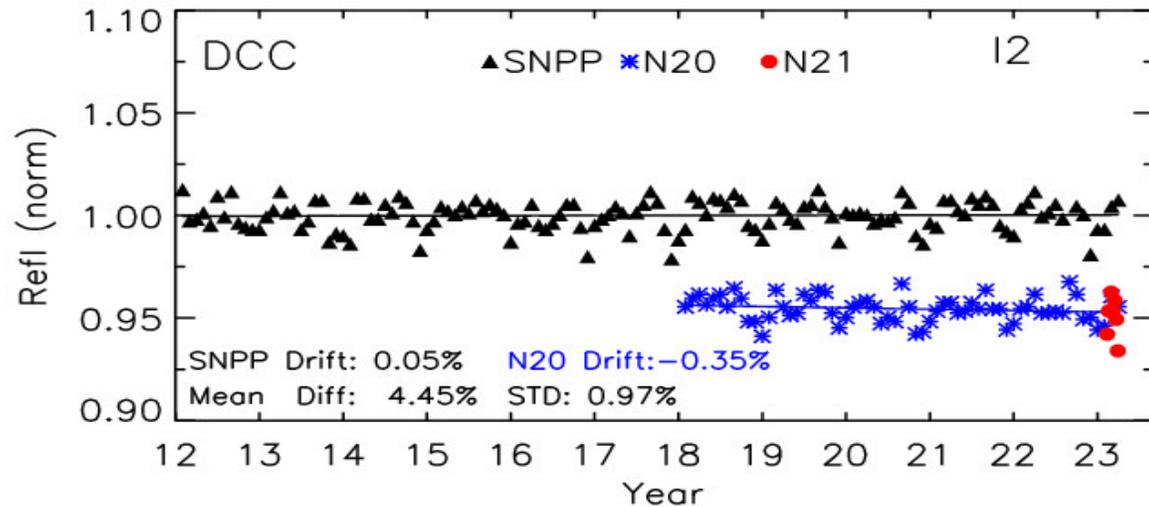
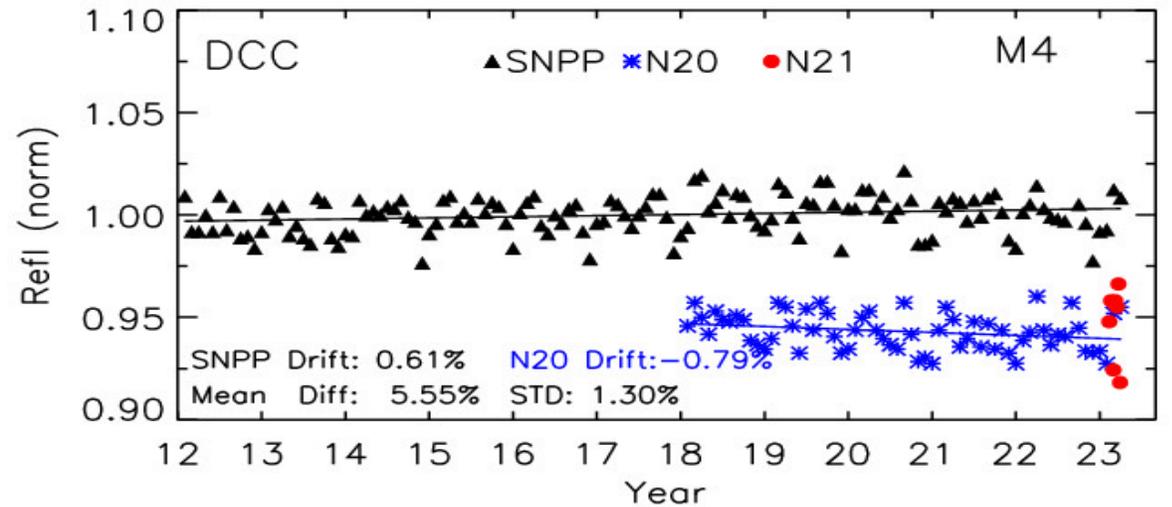
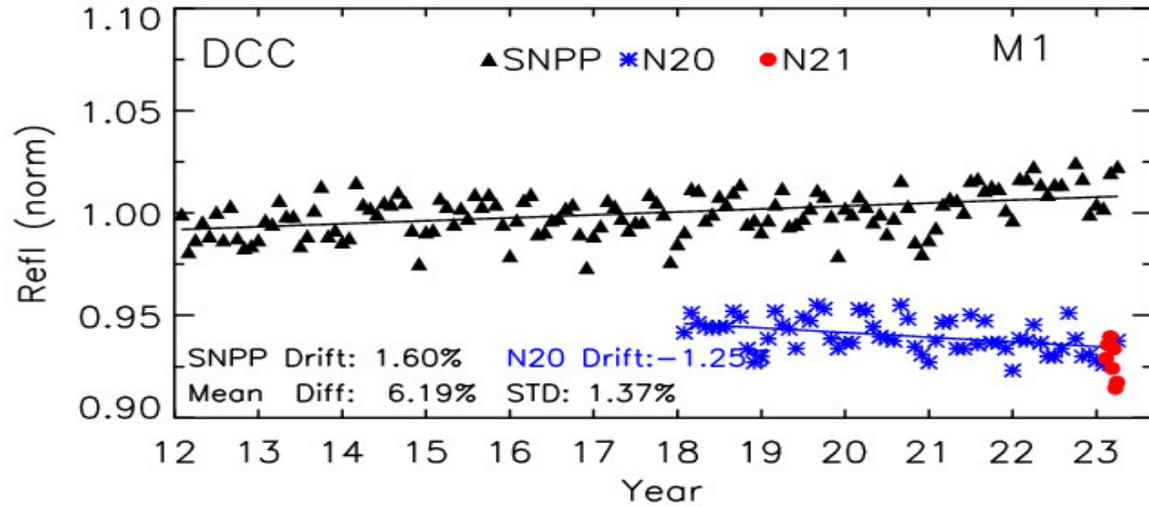


Reflectance ratio trends (VIIRS/Aqua MODIS)



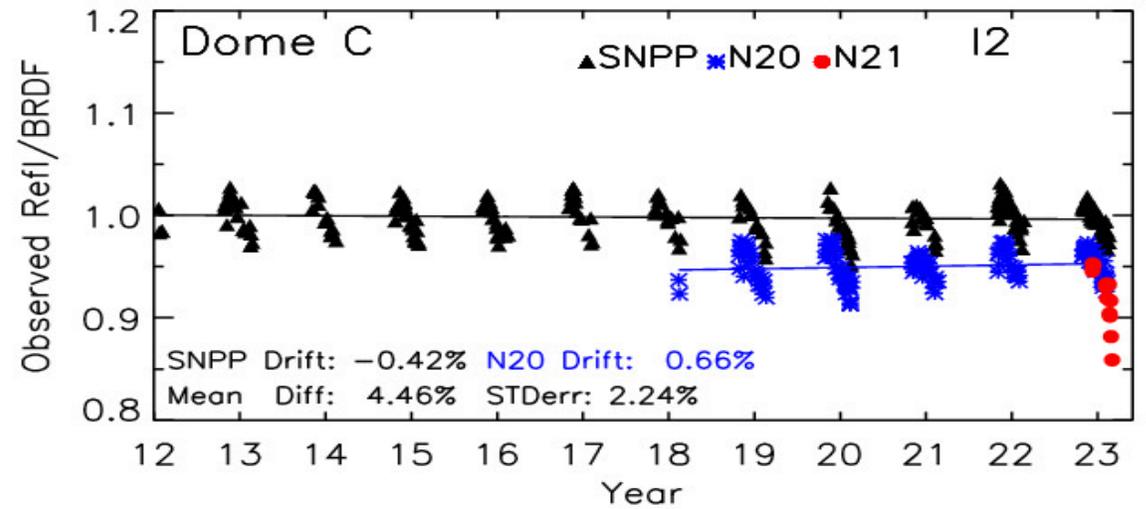
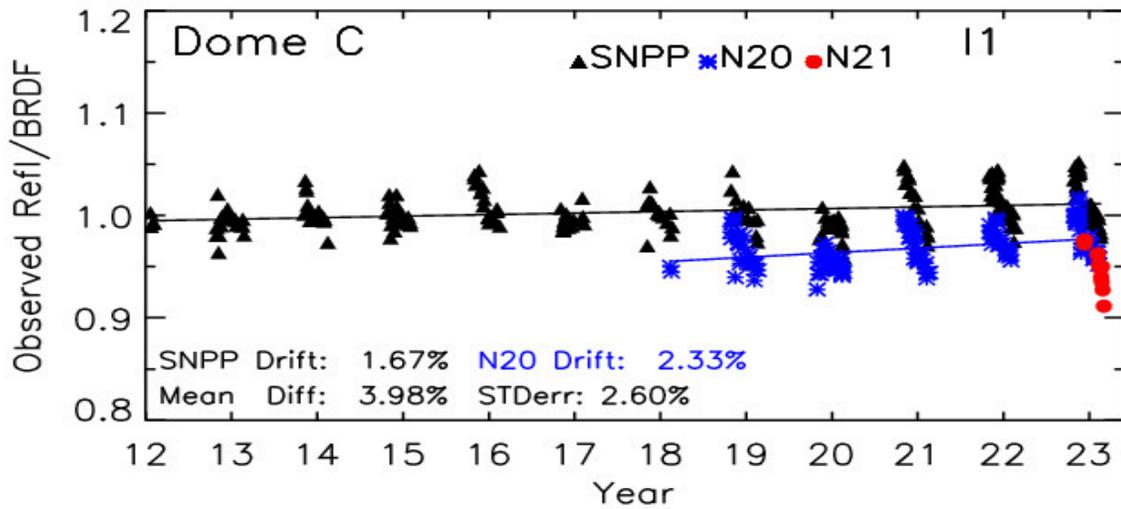
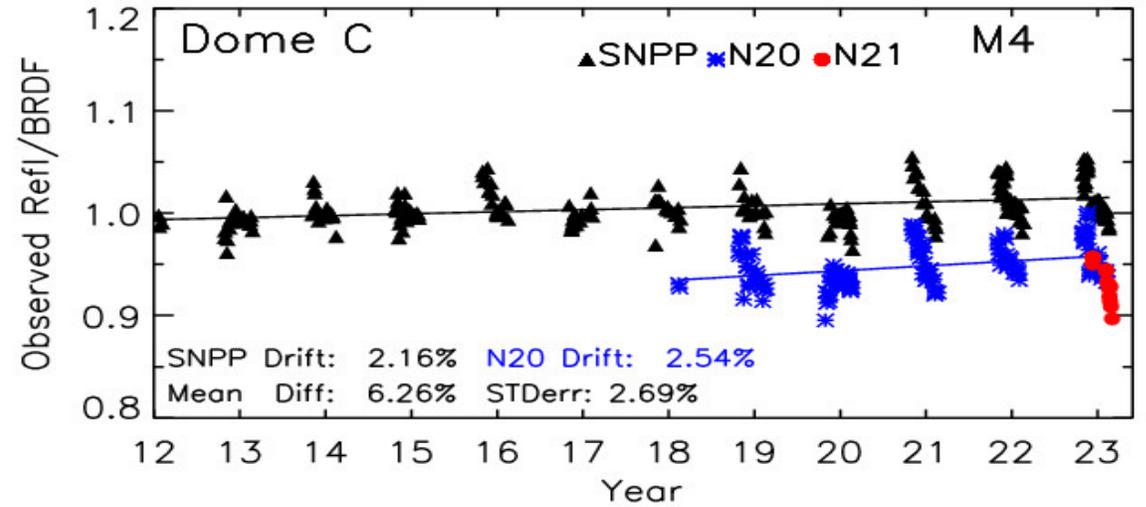
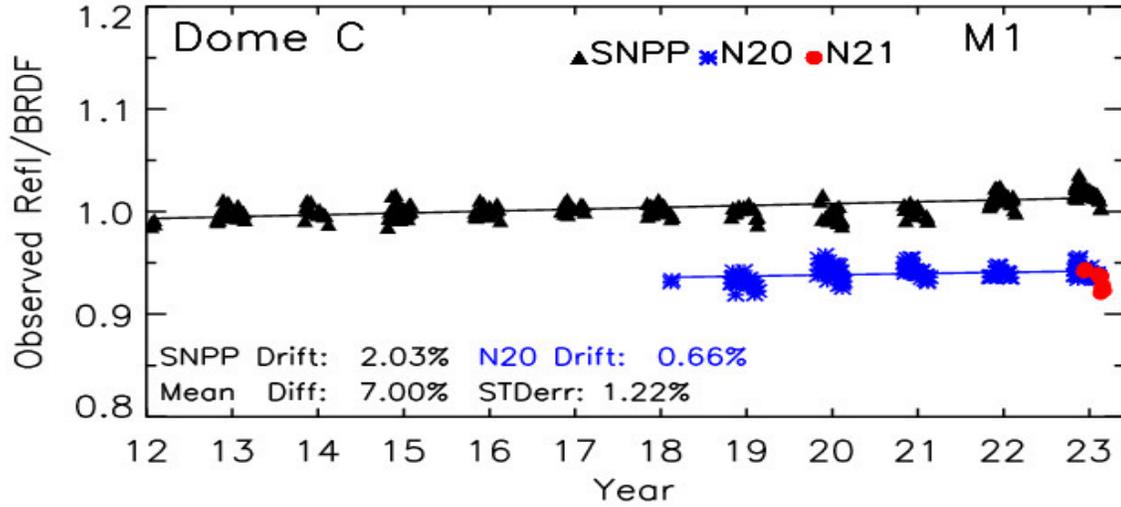


Reflectance trends over DCC





Reflectance trends over Dome C



SNPP based BRDF applied to both sensors



SNPP, NOAA20 and NOAA21 VIIRS RSB comparison



SNPP-NOAA20 (black), NOAA20-NOAA21 (red), Results provided in percentage (%)

Band (μm)	M1 0.41	M2 0.45	M3 0.49	M4 0.56	M5 0.67	M7 0.87	M8 1.24	M9 1.38	M10 1.61	M11 2.25	I1 0.64	I2 0.87	I3 1.61
Libya4	7.5 1.0	6.3 1.6	4.4 0.0	3.3 2.1	4.5 -1.7	2.7 -0.3	2.4 0.9		1.8 3.1	1.7 2.3	2.9 -1.1	2.6 -1.0	3.0 0.5
DCC	6.7 1.3	5.3 1.6	5.6 2.5	6.8 -0.4	5.0 -0.1	4.8 0.8	1.8 4.3	0.6 7.4	0.3 0.4	1.9 5.5	4.4 -0.3	5.4 0.4	2.5 -0.5
Dome C	8.3 2.1	6.7 2.4	5.0 0.9	4.7 0.1	5.1 2.0	2.4 0.9					3.3 0.9	2.6 1.2	
Aqua SNO	6.6 1.2	5.9 1.7	4.3 1.6	5.2 0.6	4.9 -0.3	3.2 0.8	2.9 0.9		3.0 1.7	4.6 5.1	3.2 0.9	3.0 0.8	3.9 1.2

**Results from NOAA21 VIIRS are preliminary based on Libya 4, Dome C and SNO approaches
RSR correction for NOAA21 is based on those from NOAA20*



Summary



- Assessment of calibration consistency among SNPP, NOAA20 and 21 VIIRS RSB is based on vicarious approaches (SNO, desert, Dome C and DCC)
- While SNPP and NOAA20 have a stability within 2% over the mission, it shows that the NOAA20 reflectances are systematically lower than SNPP by about 4 to 7% for bands M1 to M3 (shortest wavelengths) and 2-4% for the rest bands.
- Initial comparison shows that the NOAA21 VIIRS reflectances are consistent with NOAA20 to within 2% for VIS/NIR. Impacts of the spectral differences based the SBAF analysis indicate they are within 0.5% (VIS/NIR) for most scene types. For SWIR bands, large inconsistent (>5%) results are observed.
- Comparison results indicate that agreement among the different approaches are up to 2.0%, indicating errors due to limitation of each approach.